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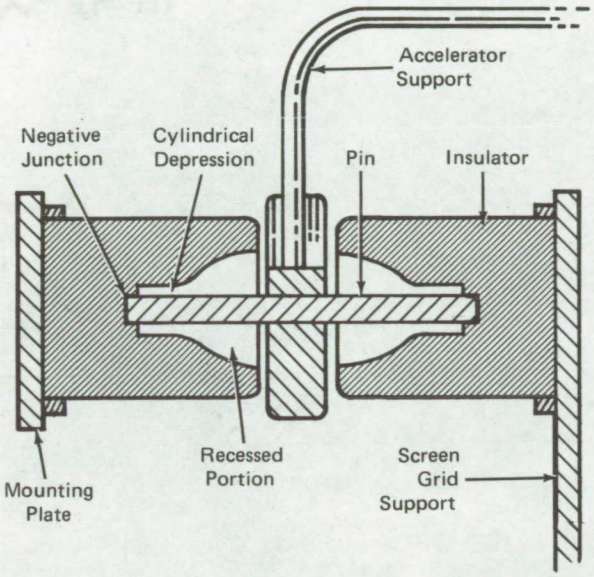
NASA TECH BRIEF

Lewis Research Center

Improved High Voltage Insulator for Use in Vacuum



An improved high voltage insulator for use in a vacuum has been devised for an electron bombardment ion thruster. With conventional spherical insulators in vacuum, electrical breakdown across the insulator usually commences with electrons drawn from the negative electrode striking the positive electrode and releasing more electrons. With an electrostatic thruster, where strong electron fields are prevalent, the electric field at a point on the negative electrode wire extracts electrons by field emission. With this improved insulator, the electric field is directed through the dielectric material and electrons emitted by field emission are constrained in the region of the negative junction. Also, there is probably some reduction in the electric field strength at this junction. In this manner, surface flashover and unstable operation at high voltages have been eliminated, and the maximum voltage the improved insulators can support is limited only by the dielectric strength of the insulator material.

The improved insulators are mounted between the screen grid support and the mounting plate as shown in the figure. Each insulator is made of a dielectric material, such as aluminum oxide, and has a flat face which engages either the screen grid support or the mounting plate. At the opposite end of the insulator is a recess which receives a pin. The pin should extend into the recess of the insulator at a distance greater than the width of the recess opening.

As shown, the recess is provided with a cylindrical depression at the bottom. This depression serves to decrease the local electric field strength at the junction between the pin and the insulator. The ratio of the penetration of the pin in the depression to the gap between the pin and the surface of the depression should be about 4 to 1.

The accelerator support which is attached to the pin is highly negative, relative to the screen grid support and mounting plate. Consequently, the pin is a negative electrode. The recess of each insulator serves to shield this negative electrode to prevent electrical breakdown at high voltages.

Conventional spherical insulators 5 cm in diameter (such as utilized in low voltage thrusters) were found to break down at 22 kV. The improved insulator design eliminated insulator flashover breakdown up to voltages of 250 kV, at which point the insulator failed due to puncture through the dielectric.

Reference:

Byers, D.C.: An Experimental Investigation of a High-Voltage Electron-Bombardment Ion Thruster, J. Electrochemical Society, Vol. 116, No. 1, January 1969.

Notes:

1. This insulator design may be of interest for other applications requiring high voltage insulation in a vacuum.

(continued overleaf)

2. Technical questions may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B72-10181

Patent status:

This invention has been patented by NASA (U. S. Patent No. 3,324,659). Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Lewis Research Center
Mail Stop 500-311
21000 Brookpark Road
Cleveland, Ohio 44135

Source: D. C. Byers, P. M. Margosian, and G. E. Mealy
Lewis Research Center
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